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THE LEARNING ENVIRONMENT.
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The learning environment is discussed in terms of environmental components or factors that should be considered by the architect. The design factors to be considered and elaborated on are as follows--(1) program, (2) function, (3)light, (4) color, (5) acoustics, (6) temperature, (7) humidity, (8) spatial conformation, (9) structure, (10) site conditions, (11) reciprocative factors, (12) organismic factors, (13) flexibility, (14) aesthetics, and (15) budget. There must be a continuing quest for excellence in design of space--to better serve the needs of students and teachers. The focus should be shifted from parts and pieces of buildings to the environment created by the space in buildings. (RK)

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THE LEARNING ENVIRONMENT

Buildings are designed to protect man from the unfriendly elements of nature--eliminating undue psychologic and physiologic stresses and substituting environmental factors that improve performance, safeguard health and lower the rate of aging.

A new discipline, environmental science is emerging. Research in this field increasingly bears out the importance of a controlled environment as a contributing factor in the learning process. The Architect should consider all environmental components--independently and in terms of the interrelationships of the various components; i.e., light affects color; temperature affects humidity; spatial conformation influences acoustics, etc.

A significant design solution results, only:

1.-If the proper approach and methodology is used in reaching design decisions, and
2.-If the proper talent is brought together on the planning "team".

The design process should be organic in nature; whereby program and function are given top billing in providing a stimulating environment, devoid of restraining psychologic and physiologic factors. Design factors are as follows:

1.-Program
2.-Function
3.-Light
4.-Color
5.-Acoustics
6.-Temperature
7.-Humidity
8.-Spatial conformation
9.-Structure
10.-Site conditions:
  a.-Climate
  b.-Topography
  c.-Neighborhood characteristics
  d.-Traffic patterns (vehicular and pedestrian)
11.-Reciprocative factors:
  a.-Activity
  b.-Clothing
  c.-Exposure
  d.-Sociology
12.-Organismic factors:
  a.-Age
  b.-Diet
  c.-Sex
  d.-Metabolism
13.-Flexibility
14.-Aesthetics
15.-Budget

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(Shaver & Co.,
Salina - Kansas)

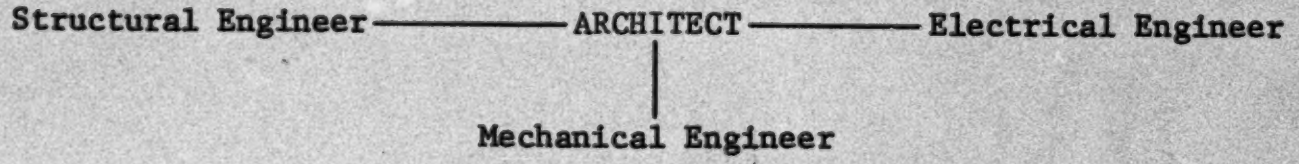
To keep the problem in proper perspective, Program and Function should be defined--in writing, spelling out educational goals, roles and responsibilities.

As the Architect starts to visualize design concepts through schematic drawings, he considers all the design factors in creating an environment for learning. The placement and movement of people and material in space is visualized in its multitudinous possibilities--then space is actually shaped in three dimensions to enclose the functions in the most simple and efficient manner. In visualizing space conformation, there should be an examination of spatial geometry, considering all the geometric forms that meet the functional requirements of the design problem. Concurrent with this, furniture and equipment schematics should be developed to test the validity of the spatial conformation and to insure that the space is free of restraining elements. At this point, and on through the entire design phase, one should guard against the intrusion of preconceived solutions interjected by any member of the design team. True creativity would then be stifled and either complete failure or mediocrity would result.

Consider a design developed around a structural module where there was an obsession with space divided into 32' x 32' x 9' cubes (a module common to many building types). Often the module is selected even before there has been an examination and study of function, as it relates to design. The result is invariably space that exerts many restraining forces to the movement and placement of people in performing their learning functions. Possibly a structural column prevents opening up a space large enough for a particular sized grouping--the shape of the space precludes an orderly and natural arrangement of people and furniture--the ceiling height is not adequate to provide proper sight lines for AV projection, large group instruction, lecture - demonstration, etc. These and other restraining elements can easily be eliminated if program and function are considered early--before design concepts are frozen.

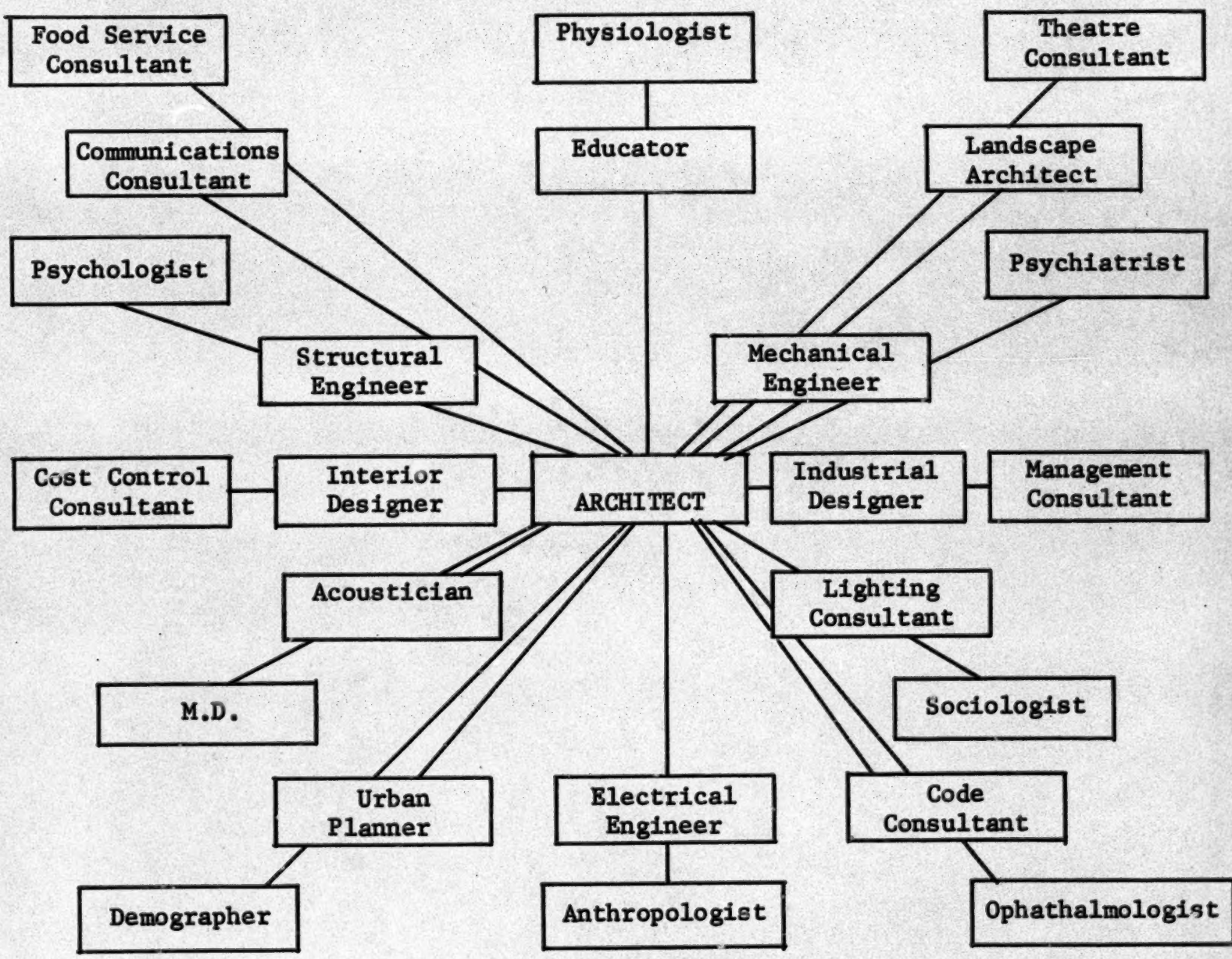
The design process will take a slightly different direction in each project; however, the Architect should, of necessity, consult with many disciplines, frequently, or as needed to check the validity of new design concepts not included in the Architects realm of experience.

Many years ago, the practice of Architecture involved the following organizational pattern:



There was little involvement with the Educator, nor was there an awareness of the importance of educational program and function in the design process. Space was designed around Architectural and Engineering "fads" and idioms. As buildings were completed, educational programs were frozen into these ill-conceived boxes and educators were left to fight a continuing battle with a drastically-restraining environment.

In more recent years, Educators and Architects alike are expressing more sensitivity to the need for a <u>total</u> design effort, organized around the organic processes, and involving a multitude of disciplines. Today, the organizational structure for a team planning effort might take on this pattern:



As our society and its problems become more complex, the Architect will need to involve himself with more disciplines in order to keep pace with human needs as they relate to space.

SPATIAL CONFORMATION

If the design solution moves toward a new or non-rectilinear geometry, the decision can be defended--if the design solution is organically conceived. Rectilinear, curvilinear, polygonal and free-form geometry should be investigated. A cardinal principle should be--geometry is important, only as it serves function.

STRUCTURE

Modern technology presents the Architect a wide choice in instructural design--as he shapes space. The same applies to the sculptor as he shapes meaning into his media. Forms reminiscent of nature are appearing in structures as their economic feasibility and practicality become more widely known. Research is needed to develop criteria essential in reaching design decisions related to structure.

LIGHT

The sense of seeing comprises a major part of the learning process. Light--artificial, natural, or a combination of both--will greatly facilitate learning, if properly used. Conversely, if improperly used, light impedes learning and even causes serious optic deficiencies requiring medical attention and/or correction.

Quality is a much more important factor than quantity. Control of glare should be maintained by holding brightness levels in the visual field to approximately 37 foot lamberts. Brightness contrasts should not exceed 10 to 1--preferably 3 to 1. "Flat" lighting should be avoided so that three-dimensional form can be easily distinguished. Failure to eliminate "flat" lighting has caused--in many recorded cases--a high incidence of myopia (near sightedness) among students esposed to this lighting condition over a long period of time. Color of light should also be controlled to avoid distortion of color on horizontal and vertical surfaces and to simulate--as close as possible--the character of natural light.

With good quality, the intensity of light levels directed on the learning task need to be no more than 50-55 foot candles--for a typical learning task, involving reading of standard size text. As the task varies, intensities will, of necessity need to vary to provide the degree of recognition and form-resolution required.

If the budget is increased to provide high light levels, there is very little, in fact often no gain in the learning rate of the student working at his task. Much research is available to document this statement on light intensities.

Also of great importance is the elimination of "visual noise" in the field of vision. This condition is created by the "bright spots" introduced with high brightness light fixtures, glaring window walls--or any elements that do not contribute to visual comfort. In addition, this "visual noise" competes for the students' attention--directing the eye away from the teacher engaged in lecturing, diverting attention from the AV screen, etc. In other words, this disturbing environmental condition reduces the students' recognition and/or resolution of audio and visual information.

COLOR

The student's perceptive sense comes into play through introduction of color. Emotional responses are exerted that can be either beneficial or harmful. The psychology of color should be thoroughly understood by the design team to avoid misuses that do violence to the nature of space.

In windowless space, color becomes even more important to allow for proper three-dimensional resolution. Although windowless space can provide a very fine environment, a feeling of claustrophobia could result if certain color combinations are used in ratios of high contrast.

In most learning spaces, colors with high degree of reflectency are desirable to maintain desired light levels on the learning tasks. Deep color tones should be used with restraint and usually in areas not involving sedentary tasks or concentrated learning situations.

ACOUSTICS

The present "State of the Art" seems to indicate that acoustical engineering is not yet an exact science; however, there are many known factors, involving sound, and its contribution to a total environment. Among these is the knowledge that learning groups can function concurrently in "open space" with little or no acoustical privacy. Evidence to substantiate this fact is coming from many educational plants across the country. Admittedly, attempts to open up space have--in some cases--met with disaster; however, the educational gains resulting from increased flexibility, are of sufficient proportions to indicate that a continued effort should be exerted in this direction.

As in many new trends, temperance is well advised to avoid problems that can occur with too much openness and overly high sound levels which act as deterrents in some learning tasks. The degree of acoustical privacy required should be carefully analyzed for every discipline and every phase of the educational program.

Oral communication comprises the major portion of the audio function, and research indicates that this type of communication is most efficient in space containing approximately 30 decibels of "White Sound" (background sound induced in space by mechanical devices, foot traffic, communicative sounds, and other background sounds involving a wide spread or mix of sound frequencies). In other words, the

student experiences better sound resolution of the spoken word with the "White Sound"--as contrasted to space substantially devoid of this background or masking sound. The ear is a very flesible organism and can adjust, readily, to varying acoustical conditions in space.

Proper placement of acoustical material will contribute greatly to sound conditions in space. Carpeting is experiencing a dramatic increase in use due to its high efficiency as an acoustical material. Impact noises, for example, are greatly reduced with this soft material under foot.

TEMPERATURE

Exacting control of temperature is an extremely important element in the total environmental picture. A case in point--72° F is the desired temperature for sedentary learning tasks performed from early childhood to the university level. For a 2 degrees of temperature rise above the ideal--with a condition where all other environmental factors are controlled--research shows that the learning rate decreases approximately 20 per cent. This decrease in learning rate continues with additional temperature rise above 74° F, but at a steadily declining rate.

Increased heart beat results with high temperature conditions. This produces a health hazard under prolonged adverse temperature conditions.

The School Planning Laboratory, University of Tennessee, conducted research on temperature readings in classrooms. Readings were recorded in the State of Tennessee consistently above the 90 degree level in fall and spring months--above 80 degrees in winter months. Even in northern climatic zones, classroom temperature readings will frequently climb well above the 80 degree level. All this research makes a strong case for year-around air conditioning (heating and cooling)--even educational plants in our northern states.

HUMIDITY

For normal sedentary learning tasks relative humidity should be maintained between 40 and 60 per cent. This can vary; however, when changing conditions are experienced in: temperature, amount and type of clothing, amount of air movement, radiation, etc. The subject is too complex to analyze in this article. Suffice it to say, humidity is of prime importance as it relates to comfort and performance of students and teachers.

Research shows a decrease in performance in too dry atmospheric conditions. Tests show readings inside schools during winter months (due to drying effect of heating systems) as low as 12 to 14 per cent--even lower than the relative humidity in some desert areas. This extreme aridity is one of the main causes of respiratory complications, and partly the reason our death rate is highest in the months of February and March.

SITE CONDITIONS

A structure, properly designed, will appear as a natural element in nature's surround. This result can only be achieved if the design concepts has been developed considering site conditions such as" climate, topography, neighborhood characteristics, traffic patterns, etc. Land contours, trees, water, rock outcroppings, ground cover, etc., are available to the designer and should be incorporated as aesthetic and functional elements. Climatic conditions will affect placement of structure and orientation to prevailing winds, etc. Flow of traffic, vehicular and pedestrian--both on the site and contiguous to the site--will affect design decisions. At this point, urban planning of spaces in close proximity should be studied, as well as the entire community master plan--to vivify any elements that would affect design decisions on the structure in question. There is a need to consider safety of students when designing for traffic flow and control. Also, the structure should appear to "belong" and be compatible with Architectural styling of the neighborhood. This can be accomplished without comprising good function and economy.

RECIPROCATIVE FACTORS

A person's reaction or sensitivity to environmental factors will change as the reciprocative factors come into play. These are:

1.-Activity.-The degree of activity or movement must be carefully analyzed. Is the activity vigorous, as in physical education--or; is it a sedentary one, such as reading--or, is it spasmodic, varying between both extremes?

2.-Clothing.-The amount and type of clothing worn is of extreme importance to the designer in determining the extent of cover separating the body from external stresses due to temperature, air movement, radiation, etc.

3.-Exposure.-To what degree is the structure sheltering its occupants? If it is minimal shelter, there is a great need for control of air movement, as an example. The orientation to sun and amount of solar infusion--or lack of same--will create varying design criteria. Sometimes one can consider a shelter with only limited protection from climatic conditions for vigorous activity.

4.-Sociology.-The number of people to be housed in space, type and size of groupings, movement and working patterns--these and others are sociologic patterns that greatly affect the total design problem. Individual study--one person performing a learning task--presents a simple problem; however, design conditions are dramatically escalated as you provide space for large groups in rather limited spatial dimensions.

ORGANISMIC FACTORS

Structural and functional characteristics of man are organismic factors that interact with all the design factors mentioned hereinbefore. These are as follows:

1.-Age.-The age grouping of people to be housed must be established. There should be a study of the behavioral patterns of children at various ages.

2.-Sex.-Numerical count on sex of people in space--their degree of association and/or isolation--must also be documented.

3.-Diet.-The caloric intake is of importance, as it relates to expenditure of available energy in performing learning tasks. Demographic studies indicate available energy output will vary greatly with changing diets in different geographical areas.

4.-Metabolism.-This is characterized by the amount of caloric intake and output--the process of change in the human body that relates to the building, storing and expending of energy. An understanding of this functional process will enhance the Architect's understanding of man's total needs.

FLEXIBILITY

Physical elements in space should stay out of the way of the educational program. Space should facilitate--not impede--the learning processes.

In the minds of many, the need for flexibility has been served merely by the introduction of folding walls. This is only a start on the problem of creating total flexibility. Complete or total flexibility, results only when all elements of the environment are capable of control. People using space should not only be able to control its dimensions--they should also be able to control; light levels and light patterns, sound, color (ability to change colors, if desired), temperature, humidity, etc. Anything short of this is not flexibility, in its true sense.

AESTHETICS

Beauty should, once again, become a respected work in our society. The taxpayer must learn that beauty need not be expensive and that it has greater emotional and cultural value for students and teachers alike. There will be greater acceptance, when our structures visually express themselves as simple, functional solutions to the needs of program and function.

BUDGET

No project can proceed without a budget; however, all is lost if this factor is the prime determinant. The design process should proceed with consideration of all the factors mentioned hereinbefore. After the total need has been conceptualized, there should then be an examination of budget to determine phasing of construction, bidding procedures, etc. Failure to proceed in this manner will invariably result in a sub-standard design solution.

One should always remember--regardless of budget--the need remains constant. Ability to finance, and procedures for finance, are separate and apart from need.

SUMMATION

The magnitude of the knowledge and comprehension required in the total design effort is staggering. The Architect must keep all design factors in proper perspective at all times as he directs the team planning effort.

Design results will be measured by the success experienced in reducing the drain on the "Physiologic Capital" of students and teachers. A child uses a major portion of his energy ("physiologic capital") for the necessities of life; i.e., growing, breathing, eating, etc. The remainder is available to expend on learning and non-learning tasks.

The real contribution comes with space free of physiologic stresses. Dr. Darrell Boyd Harmon, educational researcher of wide renown, stated the following:

"An environment free of physiologic stresses actually increases mental capabilities of students. A research study performed in El Paso, Texas (2-1/2 year duration) confirmed a $16.00 savings in the Welfare Budget for every $1.00 spent to improve environmental conditions within school buildings."

There must be a continuing quest for excellence in design of space--to better serve the needs of students and teachers. The focus should be shifted from parts and pieces of buildings to the environment created by the space in buildings.